GEOLOGY AT THE BRITISH ASSOCIATION.

THE geologists had a busy and profitable week at Bradford, and an air of business-like application to work pervaded their meetings from first to last. The programme ought to have been long enough to satisfy even the most devoted adherent of Section C; but apparently there was no sense of satiety, since on two or three occasions when it was proposed from the platform that communications should be taken as read, there were protests raised by the audience, who seemed determined to carry matters through with true North-country thoroughness, and wished to hear everything. And indeed it may be said that there was scarcely a paper in the long list which did not contain scientific matter well worthy of discussion, though it must be acknowledged that in several instances the matter was not particularly novel. It was only by the strict enforcement of a time-limit upon readers of papers and debaters, and by sessions on the mornings of Saturday and Wednesday as well as lengthy sittings on the other days of the meeting, that the business was got through Under these circumstances it was inevitable that some excellent papers scarcely received full justice; but the discussions were nevertheless unusually full of vigour, and what was still better, entirely lacking in acrimony.

The fine weather of the week, which was so favourable to the short afternoon excursions, now a recognised and highly valued feature in the affairs of the section, had probably much effect in fostering the prevailing good-humour, while the personality of the president was a strong influence in the same direction, especially in the discussions.

To particularise all the papers within the space-limits of this article is impossible, and we can only attempt to convey a general impression of the proceedings, with brief reference to the points of main interest.

On Thursday, as a fitting appendix to the wide-reaching generalisations of the president's address, already printed in these pages, we had a series of papers from Prof. J. Joly dealing with geological problems from the standpoint of the physicist. In one of these, "On the geological age of the earth, as indicated by the sodium contents of the sea," Prof. Joly reiterated the calculations and conclusions which have recently attracted so much attention in geological circles; in another, "On the inner mechanism of marine sedimentation," he showed the chemical and physical reasons for the rapid precipitation of fine solid matter brought down in suspension by rivers into the sea; a third of kindred character gave the result of "experiments on denudation by solution in fresh and salt water"; and a fourth, which was especially attractive to the petrologists and mineralogists, dealt with "the viscous softening of rock-forming minerals at temperatures below their normal melting point," showing how certain minerals could be observed to attain a plastic state some time before actually melting.

At the same meeting Prof. W. B. Scott, of Princeton, gave a highly interesting account, with lantern illustrations, of recent explorations in Patagonia conducted under the direction of Mr. J. B. Hatcher. Besides correcting previous errors as to the age of the deposits, the records and the rich collections of fossils obtained by this expedition have sufficed to prove a close connection between Australia, New Zealand and South America in Miocene times, and in several other respects to modify profoundly our previous ideas of South American geology, and incidentally to show how much geologists have still to learn in every way from the unexplored tracts of the earth's surface.

On Friday, Prof. J. Milne led off in his usual happy vein with an account of the year's work of the Seismological Committee, and was followed by Mr. Clement Reid, who showed how well-chosen, from geological reasons, was the site for instrumental observation, by the same committee, of the Upway disturbance. There then followed a series of papers and reports on the Mountain-limestone district of north-west Yorkshire and its underground waters, Mr. S. W. Cuttriss giving an account of the adventurous exploration of the deep pot-holes and caves of this district by himself and other members of the Yorkshire Ramblers' Club, and the Rev. W. Lower Carter and Mr. A. R. Dwerryhouse presenting the results obtained by a local committee and by a committee of the Association in the investigation of the subterranean drainage of the limestone. Being well-illustrated by lantern slides, these papers besides attaining their more direct purpose served to give the strangers an idea of the general characteristics of the district which was afterwards to be visited by geological excursion parties. By the use of suitable chemical reagents the course of the water from its disappearance in "sink holes" of the limestone to its reappearance in springs at lower levels has in several instances been traced; it has been shown that the main direction of underground flow is along the master-joints of the limestone; and a subterranean watershed of which there is no indication at the surface has been traced for some distance. These experiments are to be continued, and a grant of 50*l*. was made by the Association towards this end.

Among other papers taken on Tuesday were two by Mr. E. Greenly, giving further results of his painstaking researches in Anglesey. In one of these he dealt with the ancient surfaces or peneplains which he thinks can be recognised in North Wales; the older plain he is inclined to regard as of sub-Carboniferous age, and the later as Mesozoic, possibly Cretaceous. There was an interesting discussion on this paper, in the course of which Mr. Greenly acknowledged that his views were only tentatively held, and might require modification. Dr. G. Abbott then gave an account of his investigation of the concretionary structures of the Magnesian Limestone of Durham, illustrating his subject by lantern-slides and the exhibition of a large series of specimens

Saturday's business began with a paper by the President, "On a concealed coalfield beneath the London basin," in which it was urged, on data not altogether convincing, that if a boring were made in the vicinity of Enfield Lock on the Lea, it might be expected to reach Coal-measures. As a speaker in the discussion remarked, such a boring would no doubt reveal something interesting, but whether Coal-measures was another matter. Then followed a paper by Mr. R. H Tiddeman "On the formation of reef-knolls," which was practically a criticism of Mr. J. E. Marr's views as to the development of these structures in the Mountain-limestone of West Yorkshire and Lancashire by earth-movement, and a reiteration of the author's earlier contention that they were originally formed as mounds on a slowly sinking sea-bottom. As Mr. Marr was present to champion his own cause, the paper was followed by a brisk but friendly discussion, which was prolonged on a later day in the open air, when some of the mounds at Cracoe near Skipton were visited by a few members interested in the subject. No definite conclusion was reached, but the necessity for further investigation was made evident, and it was suggested that the truth might lie in a combination of the two hypotheses.

Another paper taken on Saturday was that of Mr. W. Gibson, "On rapid changes in the thickness and character of the Coal-measures of North Staffordshire," in which it was shown that the areas of maximum and minimum deposit in these rocks correspond respectively with a syncline and anticline, thereby suggesting that local areas of deposit were being marked out by contemporaneous movements of elevation and depression, thus fulfilling in North Staffordshire the conditions characteristic of the Carboniferous rocks of the Midlands generally. These results have an important practical application, inasmuch as the unexplored coal-field to the westward, which occupies a syncline, may thereby be expected to exhibit an increase in the thickness of the strata. At the same meeting, Rev. J. F. Blake brought forward some revolutionary suggestions in regard to the registration of type-specimens, among other proposals urging that a new class of "adopted" types should be recognised and registered where the original types were missing or inadequate, and that the type should consist of a single specimen. As Prof. Blake has now been elected a member of the committee of the Association at present in existence for furthering the registration of type-specimens, we may hope that his interest in the matter may bear fruit.

On Monday there was a crowded audience to hear the joint discussion with the botanists on the conditions during the growth of the forests of the Coal-measures. The discussion was opened by Mr. R. Kidston, who gave a succinct account of the plant-life of the period, illustrated by fine lantern slides. Mr. A. Strahan then dealt with the physical conditions, and gave his adherence to the "drift" as opposed to the "growth-in-place" theory of the origin of coal-seams, summing up the normal sequence of events in the formation of a seam as follows:—First, the outspreading of sand and gravel with drifted plant remains; followed by shale as the currents lost velocity; and then a growth of presumably aquatic vegetation in extremely shallow water into which wind-borne vegetable dust and floating vegetable matter was carried; after which renewed subsidence brought in the sand and mud-laden currents again and the whole process was recommenced. Mr. A. C. Seward followed with a clear statement

of the botanical evidence bearing on the climatic and other physical conditions under which coal was formed; and Mr. J. E. Marr continued with a general outline of the geological evidence, laying stress on the peculiar coincidence during the Carboniferous period of a dominant vegetation of giant cryptogams with extensive plains of sedimentation and suitable climatic conditions. The debate thus initiated was then thrown open to the meeting and was carried on briskly by numerous speakers, among whom were Dr. Horace Brown, who gave the result of his experiments on the growth of plants in an atmosphere containing a slight excess of carbonic acid gas, and showed a series of lantern slides illustrating these experiments; Prof. P. F. Kendall, who supported the growth-in-place theory for most coals except cannel-coal; Mr. R. D. Oldham, who referred to the absence of seat-earths or under-clays to the seams in the Indian coal-fields; Dr. D. H. Scott, Dr. H. Woodward, Dr. H. O. Forbes, Dr. Wheelton Hind, Dr. Le Neve Foster, Mr. W. Cash, and others. In winding up this somewhat discursive debate, which had occupied the whole of the morning, the president leant strongly towards the growth-in-place theory, and this view was evidently also in favour with the greater portion of the audience.

Dr. E. D. Wellburn next gave two papers on the fossil fish of the Yorkshire Coal-field and of the Millstone Grits. Mr. J J. H. Teall, President of the Geological Society, then described the plutonic complex of Cnoc-na-Sroine (Sutherlandshire), and discussed the three possible ways in which it may have originated, viz. by (1) successive intrusions; (2) differentiation *in situ*; or (3) modification of the original magma by the absorption of adjacent basic rocks, the conclusion being that the first method has not in this case played an important part, and that the second, coupled perhaps to some extent with the third, has been the main agent in forming the complex. Prof. K. Busz, of Münster, followed with a paper on a granophyre dyke intrusive in gabbro at Ardnamurchan (Scotland), in which it was shown that the granophyre in question has absorbed a considerable quantity of basic material from the previously consolidated gabbro, and has thereby added hornblende and mica to its proper constituents. Both papers provoked lively discussion.

Tuesday was essentially the glacialists' day and they made vigorous use of it, occupying nearly the whole session. Time was found, however, at the opening for a paper by Miss Igerna B. J. Sollas, "On *Naiadites* from the Upper Rhætic of Redland, Bristol"; and there was another break at the close, when Prof. A. P. Coleman, of Toronto, gave an account of the recent discovery of a ferriferous horizon in the Huronian north of Lake Superior, where a band of iron-bearing sandstone and jasper has already been traced for sixty miles in the Michipicoton district, and promises to be of great value from both the economic and the scientific standpoints, as it furnishes an easily-recognised horizon, probably equivalent to that containing the most famous iron mines of the United States, and affords an excellent clue to the stratigraphy.

Of the glacial papers, the first, by Mr. F. W. Harmer, was a theoretical discussion of the influence of winds upon climate during past epochs, in which it was sought to restore hypothetically the distribution of cyclonic and anti-cyclonic areas during the Pleistocene period, and to explain in this manner the phenomena of interglacial periods, which the author believes to have occurred alternately in the eastern and western continents, the conditions of comparative warmth and cold during this period having been local and due directly to meteorological causes. Then followed a series of excellent papers on the glacial phenomena of the West Riding, by Dr. Monckman, Mr. E. Wilson, and Messrs. A. Jowett and H. B. Muff, in which particular attention was drawn to the former existence of glacially-dammed lakes in the side valleys draining to the Aire, and to the overflow channels cut by the streams which had their source in these lakes. The glaciation of the East Riding was afterwards dealt with in two papers by Mr. J. W. Stather; and Mr. R. H. Tiddeman brought forward evidence proving that the raised beach of Gower in South Wales, with the bone-beds which rest upon it in the caves, must be either of pre- or inter-Glacial age, since they are overlain by glacial drift; this matter is of much consequence in the correlation of Pleistocene deposits of the unglaciated parts of our island with those of the glaciated tracts.

At the final meeting on Wednesday morning, Mr. R. D. Oldham discussed the mode of formation of the Basal Carboniferous Conglomerate of Ullswater in the light of his Indian experience, and suggested that it was a torrential deposit formed on dry land near the foot of a range of hills, in a generally dry and hot climate varied by seasonal or periodical bursts of rain. In a second paper Mr. Oldham called attention to good examples of new beach-formation on the shores of Thirlmere Reservoir, and recommended that a photographic survey should be made from time to time to record the progress and growth of this beach. Mr. W. H. Crofts followed with a careful and well-illustrated account of sections in Glacial and post-Glacial deposits in a new dock at Hull; and Mr. A. C. Seward gave a summarised description of the Jurassic flora of the Yorkshire coast, with many fine lantern illustrations. Mr. G. W. Lamplugh afterwards reviewed the evidence as to the age of the English Wealden series, and supported the long-accepted but recently questioned view that the whole of the time-interval between the closing stages of the Jurassic and the commencement of the Aptian is represented.

The reports of committees of research read during the meeting included, among others, Prof. W. W. Watts', on the collection and preservation of geological photographs; Prof. P. F. Kendall's, on erratic blocks of the British Isles; Dr. Wheelton Hind's, on life-zones in British Carboniferous rocks; and Prof. A. P. Coleman's, on the Pleistocene beds of Canada.

The short afternoon excursions were under the leadership of Mr. J. E. Wilson, Mr. H. B. Muff and Dr. Monckman, who were thus able to show in the field some of the phenomena which they had described in their papers. These excursions were well attended and much appreciated by the visitors from a distance, who in this way were enabled rapidly and pleasantly to gain a grasp of the leading features of the local geology.

A well-arranged temporary museum, under the supervision of Mr. J. E. Wilson, for the exhibition of specimens illustrating the papers and the coal-discussion, was located in a large room adjoining the section room, and was especially serviceable in enabling those interested in the particular subjects illustrated to examine the material at their leisure and to compare notes upon it with the exhibitors. The lantern, so often a source of annoyance at the sectional meetings, was ably managed throughout; and indeed the whole of the local arrangements for the accommodation of the section were admirably planned and carried out, the only drawback being that the noise of heavy traffic on the stone pavement outside was at times troublesome.

To sum up the week's work, it may be remarked that there was an unusual number of papers dealing with subjects of broad general interest and therefore well suited for public discussion, and a scarcity of those detailed studies in stratigraphy or classification which, though probably of more permanent scientific value, are ill-adapted for presentation at these meetings; the local papers also were numerous and well above the average in character; petrology and palæontology were both adequately represented; but systematic geology received little attention.

The morning meetings were well attended throughout, but, as usual, in the afternoons only the devoted nucleus of the section remained.

ZOOLOGY (AND PHYSIOLOGY) AT THE BRITISH ASSOCIATION.

THE opening day (Thursday) was devoted to the president's address in the morning and the reports of various committees in the afternoon. The reports were as follows:—

(1) Bird migration in Great Britain and Ireland.—Mr. Eagle Clarke has completed the extraction of the voluminous records of occurrences of birds in Great Britain and Ireland from the periodical literature of 1880-1887. The information thus provided supplements in a most useful manner the original Light-house data, and renders it possible for the first time to write an authoritative history of the migrations of each British bird. Mr. Clarke begins the series with a summary of details of the various migratory movements of (i) the Song-Thrush (*Turdus musicus*) and (ii) the White Wagtail (*Motacilla alba*).

(2) Investigations at the Naples Zoological Station.—The utility of the British Association's table was again demonstrated by the number of naturalists who had occupied it during the year. Reports on work done there were submitted by Mr. H. M. Kyle (anatomy of flat-fishes), Mr. E. S. Goodrich (structure of certain polychæte worms), Prof. W. A. Herdman (Compound Ascidians), Mr. R. T. Günther (anatomy of *Phyllirhoë* and certain Cœlenterates), Dr. A. H. R. Buller (fertilisation process